Infiltration Conditions

1. No ponding: H = 0
   - $I^*(t) \geq r(t) = I(t)$
   - Infiltration is *supply controlled.*
2. Saturation from above: H > 0
   - $r(t) > I^*(t) = I(t)$
   - Infiltration is *profile controlled.*
   - Initially, r(t) high; surface soil saturates quickly.
   - Lower layers remain unsaturated.
3. Saturation from below: H > 0
   - $r(t) > I^*(t) = I(t)$
   - Ponding develops much more slowly than in #2.
   - Typically starts as #1.
   - Water table rises to surface; entire soil column is saturated.
   - Then we define as #3

Saturation from above. Note percolation to lower layers.

Terms:
H – Height of ponding [L]
$I^*(t)$ – Infiltration capacity [L/t]
I(t) – Infiltration rate [L/t]
r(t) – rainfall rate [L/t]

Infiltration Rate Limiting Factors

- Precipitation or irrigation rate
- Hydraulic conductivity of the soil
  - Soil texture
  - Water content
  - Organic content
  - Frost


Mudcracks with inwashed sand.

- Compaction by precipitation, biological, or geologic activity
- Inwashing of fine particles
- Inclination and roughness of soil surface

Summary

- The relationship between tension head $\psi(\theta)$, unsaturated hydraulic conductivity $K(\theta)$, and water content θ is highly non-linear.
- Soil texture determines how a soil wets and dries.
  - Small and large pores fill and drain differently.
- The relationship between soil texture, initial water content, and water input rate determine the infiltration condition.